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AMBER MODEL 358

HIGH RESOLUTION FREQUENCY METER

OWNER'S HANDBOOK

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AMBER MODEL 358

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OWNER'S MANUAL

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SECTION 1

GENERAL INFORMATION

SECTION 1 GENERAL INFORMATION

1.1 INSTRUMENT DESCRIPTION

The Amber model 358 High Resolution Frequency Meter is an accessory to the Amber model 3501 Distortion & Noise Measuring System. The model 358 provides a digital readout of frequency of various signals generated by the model 3501. It is supplied in a metallic enclosure which attaches to the top of the 3501 adding approximately one and one quarter inches to the height of the instrument. Pushbuttons on the front of the 358 allow it to measure frequency of the signals available at the oscillator output, the raw input or the amplified and filtered input signal on the 3501.

The 358 provides a digital readout of frequency with a one hundred fold improvement of displayed resolution and measurement speed over more conventional frequency meters. At frequencies below 10kHz the readout provides a resolution of 0.1Hz with a gate time of 100msec. Six digits are provided.

An additional high resolution mode is provided to further extend the low frequency resolution to 0.01Hz. In this mode, the gate time is 1 second.

The 358 has an upper frequency limit well above 500kHz and can typically measure to frequencies as high as 1.2 MHz.

A signal level detector automatically blanks the display if the input signal level is too low for a valid reading.

The meter provides automatic frequency ranging in Hz below approximately 10kHz and kHz above approximately 10kHz. A manual override is provided to disable the autoranging feature.

1.2 SPECIFICATIONS

FREQUENCY RANGE	:	10Hz to 500kHz
DIGITS	:	6
RESOLUTION	:	0.1 sec gate:(normal mode) 10Hz to 10kHz : 0.1Hz 10kHz to 500kHz : 10Hz
	:	1 sec gate:(high resolution mode) 10Hz to 10kHz : 0.01Hz 10kHz to 500kHz : 1Hz
ACCURACY	:	±0.05% of reading ±1 count
SENSITIVITY	:	Valid measurement for on scale meter readings on the 3501.
POWER REQUIREMENTS:		10V to 16V DC at typically 150mA (provided by 3501)
DIMENSIONS	:	1.2" H x 7.7" W x 8.5" D.

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SECTION 2

OPERATING INFORMATION

Section 2 OPERATING INSTRUCTIONS

2.1 GENERAL

The 358 is powered by the 3501 power supply. It can only be turned on if the 3501 itself is turned on. When the host 3501 is switched off the 358 also automatically switches off. Pushing one of the three input select pushbuttons will cause the 358 to turn on and illuminate the LED in that pushbutton. Pushing the selected input a second time will turn off the 358 and extinguish all LEDs. If the 3501 is operating under battery power the 358 should be turned off whenever not required to conserve battery life.

2.2 INPUT SELECTION

The 358 can look at three signal locations in the host 3501. The first pushbutton, labelled OSC, allows the 358 to read the frequency of the internal 3501 oscillator. It will always give a valid frequency reading even if the 3501 output attenuator is set to a low level. When the 3501 is in the IMD distortion function the frequency meter reads the high frequency portion of the composite signal.

The second pushbutton, labelled INPUT, is normally used in the distortion mode to measure the frequency of the fundamental signal. It measures the frequency of the signal available on the rear panel input monitor connector. It requires that the input control be set to the correct position, that is, with both red LEDs extinguished. As in the distortion mode, the signal must be higher than -30dBm.

The third pushbutton, labelled MONITOR, measures the signal available on the front panel monitor connector, which is the same signal being measured by the meter itself. This will be the most commonly used position as it allows signal level measurements over the full operating range of the instrument. However, in the distortion mode the monitor output contains the distortion residual components. These will typically contain a large amount of noise and will give erratic frequency readings. Therefore in the distortion mode the incoming frequency should be measured by pushing the INPUT pushbutton.

To measure the frequency of very low level signals use the narrow band measurement capability of the 3501 and push the MONITOR pushbutton. This allows the use of the bandpass filter in the 3501 to attenuate the noise components and improve the validity of the measurement. In addition, the high pass and low pass

filters may be used when the MONITOR signal is selected.

To summarize, use the OSC pushbutton to measure the frequency of the oscillator. Use the INPUT pushbutton to measure the frequency of the fundamental in the distortion mode and use the MONITOR pushbutton for all nondistortion modes to measure the incoming signal.

2.3 SHIFT FUNCTIONS

In addition to their normal function of signal selection, the three input select pushbuttons can serve additional functions. When the SHIFT pushbutton is depressed the input select pushbuttons serve a completely different function. Their new shifted function is designated by illuminated labels appearing below the pushbuttons. The first two pushbuttons allow manual override of the frequency autoranging. The third pushbutton allows manual selection of the high resolution mode.

The frequency meter normally autoranges at approximately 10kHz, reading in Hz in the low range below 10kHz and in kHz in the high range above 10kHz. This autoranging can be overridden by pushing and holding the shift button while pushing the Hz or kHz buttons. For example, to force the instrument to remain in the Hz or low frequency mode, first select the appropriate input, then push and hold the SHIFT button then push the first button labelled Hz (while holding SHIFT). In this mode however, as the incoming frequency exceeds 10kHz, the meter will eventually be unable to make the reading and will simply display a zero. This will occur typically around 12kHz. Similarly, the meter can be forced into the kHz mode by selecting the appropriate input then pushing and holding the SHIFT button while pushing the kHz button. In this mode the meter will function over the full frequency range although, since the resolution is 10Hz, frequencies below 100Hz or so will show very poor resolution.

When in the manual mode the letter M will illuminate in the display area to the left of the digits.

The meter normally has a measurement gate period of 100mSec. This is intended to give fast readings and allow rapid manual tuning of the 3501 oscillator. However, this gate period can be changed to be one second and gain an additional digit of resolution. This gives a resolution of 0.01Hz in the low frequency mode and 1Hz in the high frequency mode. To select the high resolution mode first select the input as before, then push and hold the SHIFT button while pushing the 1Sec pushbutton. The display will shift the decimal point to the left and show an additional digit of resolution.

To deselect a shifted mode and go back to normal operation simply push the selected input, turning the 358 off, and then select the required input again turning the 358 back on into its normal mode. This will cancel any of the shifted functions and return the instrument to the automatic ranging 100mSec mode.

Under particular, and perhaps unusual circumstances, it may be desirable to enter two shifted functions simultaneously. This can be done but it requires somewhat tricky finger pushing. The meter is purposefully configured this way to prevent accidentally entering these unusual modes.

For example, to select the manual low frequency mode and the high resolution mode simultaneously, first select the appropriate input in the normal manner. Then push and hold down the SHIFT button. While holding the SHIFT button depressed, push and hold both the Hz and the 1Sec pushbuttons. Now while continuing to hold the Hz and 1Sec pushbuttons, momentarily release and then again push the SHIFT pushbutton. Finally release all three buttons and the meter will now be in the manual, low frequency, high resolution mode. Again to cancel this mode push the selected input pushbutton which turns the meter off and then reselect the input to be back into the normal mode.

2.4 Additional Points

To the left of the digital display is an upward pointing arrow. This is an overrange indication which, under normal modes, will never come on. However, if the display should exceed 999999 this arrow will come on indicating an overrange condition and in fact an invisible seventh digit to the left of the six digit display. For example, a reading of a 1MHz signal in the high resolution mode would be indicated as an overrange indication followed by six zero digits. The normal 100 mSec gate mode will show all of the digits displayed but leave off the right most digit, that is, the unit Hz indication. Shifting to the high resolution mode will shift the display one digit to the left cutting off the highest digit but showing the right most digit. By manipulating the display in this way it is possible to effectively have a seven digit readout.

Note that when in the manual Hz mode, signals beyond the range of the frequency multiplier, that is beyond approximately 12kHz, will show as an invalid reading rather than an overrange indication. The display will indicate a zero and the overrange indication will not be illuminated.

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SECTION 3

INSTALLATION INSTRUCTIONS

SECTION 3 INSTALLATION INSTRUCTIONS

3.1 Installation of a model 358 in a model 3501

Installation involves both mechanical work and electrical connections. The mechanical work is shown in the assembly instructions. It involves attaching the 358 to the top cover of the 3501 and creation of a hole to allow cables to pass through into the instrument.

The 358 is attached to the top cover of a 3501 using four screws which pass through four existing bosses in the top cover, a washer, a nut, the chassis of the 358, a threaded spacer and finally the primary circuit board of the 358. The drawings show the locations of these bosses, which must be drilled with a 1/8 inch diameter bit to accept the 4-40 screws, and the orientation of the various spacing washers.

A rectangular hole approximately 1/2 inch by 1 inch must be made in the plastic top cover of the 3501 to allow cables to pass through from the 358 to the various points in the 3501. This hole should be located as shown in the drawings directly under a similar hole in the 358 chassis.

There are three sets of cables which connect the 3501 to the 358. The first set consists of four individual wires which connect in the power supply section of the 3501. The second set is a two conductor shielded cable which connects to the oscillator section of the 3501 and the third set is two individually shielded single conductor cables which connect to the analyser section of the 3501. The drawings show the connections of these three sets of cables.

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SECTION 4

MAINTENANCE and CALIBRATION

SECTION 4 MAINTENANCE AND CALIBRATION

4.1 GENERAL

The model 358 frequency meter requires essentially no periodic maintenance. All calibration adjustments are noncritical, are factory set and should not require any field adjustment. However, the following description will indicate the function and purpose of each of these adjustments.

V801 is a variable capacitor which provides a small adjustment of the reference frequency used for the frequency counter. The time base is formed by a 10.0000MHz crystal and V801 provides a small adjustment of this nominal frequency. If an external, highly accurate, 1MHz reference is available, this control may be used to trim the reading of the 358 to correspond exactly to this external reference.

V802 sets the frequency autoranging changeover point. It is normally set to autorange at approximately 10kHz. As there is some hysteresis the down switching point will differ from the upward switching point. It is set by slowly sweeping an incoming signal up and down from approximately 7kHz to 13kHz and noting the switchover point. V802 is adjusted so that the mean value of the upward and downward switchover point is approximately 10kHz.

V803 sets the 10V supply voltage of the 358. It is adjusted by measuring the voltage on the collector of Q800, which is the large transistor on the heat sink at the back of the board, to be exactly 10V with respect to ground. Note that the 5V rail has no adjustment and is set by a 5V regulator.

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SECTION 5

THEORY of OPERATION

SECTION 5 THEORY OF OPERATION

5.0 GENERAL

The model 358 digital frequency meter is optimized for low frequency operation. It incorporates a frequency multiplier circuit using a phase locked loop to gain a 100 fold improvement over conventional frequency meters in terms of resolution and speed.

It is also designed to retrofit the model 3501 Distortion and Noise Measuring Set. It has been designed to draw its power and signals from within the 3501 to form an integrated system. CMOS circuitry is used extensively to reduce power consumption and optimize 3501 battery life.

The 358 may be subdivided into four major subsections: Power supply, analog circuitry, digital circuitry and front panel components with related drive circuitry. Each will be described separately.

5.1 Power Supply

Referring to schematic number 1 the upper right hand quadrant shows the 358 power supply. Power for the frequency meter is derived from the host 3501 and may come from either the raw battery voltage or the rectified and filtered AC mains voltage. These voltages enter on pins 4 & 3 of J801 respectively. Pin 2 comes from the 8V regulated supply inside the 3501. It is used both as a reference and to detect the power-on condition of the 3501. The 358 may only be turned on if the 3501 is also turned on.

All of the static CMOS logic of the 358 is powered all the time when the 3501 is on as its power drain is extremely low. If the 3501 is turned on, then +8V regulated will appear on pin 2 of J801 and this will cause the power supply of the 358 to turn on providing the 10V and 5V supply rails to the instrument.

Q800, 801, 802 and 803 form a series pass regulator using the 8V regulated rail from the 3501 as a reference. The raw unregulated nominal 12V signal available on pin 3 or 4 of J801 is the unregulated source and provides a 10V regulated rail on the collector of Q800. V803 allows a small range of adjustment of this nominal 10V rail. The LM309 three terminal regulator, U803, provides a regulated 5V rail for most of the logic and LED displays. D830, a TL430 shunt regulator, provides a floating

analog ground (shown by the circled ground symbol) of approximately 2V. This analog ground is used to provide some level of bipolar performance of the operational amplifiers used in the circuit.

5.2 Analog Input Circuitry

The model 3501 incorporates a floating oscillator. To couple this floating source into the grounded circuitry of the 358, U842B is configured as a differential amplifier. The floating oscillator signal appears on a differential input on pins 3 & 4 of J803. The configuration of U842B provides a single ended, ground referenced output on pin 7 of the floating oscillator signal.

Signals from the input preamplifier of the 3501 and the meter measuring circuit (monitor) appear on J802. U841A & B provide input buffering of these signals.

All three signals appear as inputs to U835, a CMOS three pole, two position switch. The three input signals are coupled through N803, a 10k resistor network. The signals on these resistors may be connected either to ground or the additional amplification provided by U842A & U834B. Only one signal is selected at a time by logic described elsewhere. Pins 9,10, and 11 are the logic inputs of the three form-C switches. When an input is selected a high level, that is 5V, will appear on Pin 9, 10 or 11. The other two pins will be a low level, that is ground.

5.3 ZERO CROSSING DETECTOR and FREQUENCY MULTIPLIER

U842A & U832B provide AC coupled gain to amplify the signal before being presented to U833, the zero crossing detector. Approximately 12dB of gain is provided. U833, an LF311, is a zero crossing detector which converts the incoming waveform, typically a sine wave, into a clean square wave on pin 7. This signal is called F_{in}. F_{in} is a general clock used in several places in the logic circuit to be described elsewhere. It is also an input to U832, a 4046 phase lock loop (PLL). U831 is a dual decade counter configured as a divide by 100 circuit. This divide by 100 counter is inserted in the feedback path of the PLL, the net combination forming a times 100 frequency multiplier circuit. The signal available on pin 4 of U832 is coupled through R820 and C810 and becomes F_{in} times one hundred.

The phase lock loop U832 used in the frequency multiplier circuit has a finite signal acquisition time prior to locking. The locked condition of U832 is determined by monitoring pin 1 which is done both by U834A and Q804. U834A detects a locked condition

and provides a LCKD signal to the rest of the circuitry. Q804 with C816 and R834 is a switchable low pass filter to reduce noise in the low frequency mode.

The zero crossing detector formed by U833 has a lower threshold limit set about 20dB below the full scale signal level. When signals fall below this limit, no F_{in} clock is output from U833, pin 7. Succeeding logic circuitry to be described recognizes this and blanks the display.

5.4 Input Selection Logic

Referring to schematic 2, U803, 814 & 813 and associated gates form the input selection latches. Input selection pushbuttons S800,801 & 802 are momentary and their status is latched by U803, a 4076 quad D flip-flop. When either of the three pushbuttons is pushed a momentary high is generated by U823, pin 9. R811 & C802 differentiate this to produce a clock edge available on pin 10 of U811. This is directed either to the clock input of U803 or U813 as a condition of whether or not the SHIFT pushbutton is operated. This configuration allows interlocking operation of the three pushbuttons with one on at a time. The output of U803 is decoded by U814 with pins 14, 2, & 1 representing input selections of oscillator, input and monitor respectively. These signals are used to drive the CMOS switch U835 described previously and the LED drivers formed by U801 & U802 to illuminate the LEDs in the pushbuttons.

5.5 ON/OFF STATUS

U821A is also clocked with the edge derived by pushing either of the input select pushbuttons. Its purpose is to turn the 358 ON or OFF. A high on pin 2 represents an ON condition. This does several things. It removes the reset condition on U813, the SHIFT function latch. The reset condition during OFF is used to clear any set-up shift functions.

The ON condition also removes the reset of U830A, a monostable multivibrator. This circuit is configured as a "missing pulse detector" with a time constant set to about 8Hz. In the absence of F_{in} clock signals, such as when there is no input information, it removes the qualifying input on U820A and this results in a blanking of the digital display.

5.6 FREQUENCY RANGING

U821B latches the state of frequency range. With a high on pin 13, the meter is in the kHz or high range. A low indicates the Hz or low range.

In the normal automatic mode, the state of U821B is determined by U830B. The time constant formed by V802 and C809 in conjunction with the F_{in} clock on pin 12 measures the input frequency. With V802 set properly, it changes state at approximately 10kHz. This qualifies U820B which in turn qualifies U821B. This monostable, like U820A, is configured as a missing pulse detector.

U810 is a CMOS dual four by one switch. It is used to control the range and decimal point position input on U800. The control signals are on pins 9 and 10 of U810 and come from the range latch, U821B and the shifted high resolution mode latch, U813.

5.7 DECADE COUNTER

U800 is an Intersil ICM7226 LSI frequency counter. It can drive up to 8 digits in a multiplexed fashion (six are driven in this application). It contains an internal 10MHz oscillator, completed by the components on pins 35 and 36. V801 allows minor adjustment of the operating frequency, largely determined by crystal X800.

The input signal to be measured is presented to pin 40, the A input. This signal is either F_{in} or F_{in} times 100 as determined by steering logic U824, pin 11 and U822, pin 10. This in turn is controlled by the range latch U821B.

The reset input on pin 19 is driven by the PLL lock detection circuit described earlier. In the absence of a LCKD condition during the Hz mode, a zero is displayed.

U800 directly drives the six common anode LED displays. Discrete LED D801 is the overflow indicator set-up to indicate the B segment of digit seven. This segment would be on if any digit other than 6 were displayed. In practise, only a one or two could be displayed representing 1 or 2 MHz.

5.8 LED DRIVE

U801 and U802 are quad operational amplifiers set up as comparator-drivers for discrete LEDs. Their reference input is analog ground (approximately +2V with respect to logic ground). They sense various circuit logic points and drive the appropriate LEDs via current limiting resistors.

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SECTION 6

PARTS LIST

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
A810	13581-41001	PCB FRONT PANEL			AMBER	13581-41001	1
A815	13581-41151	FRONT PANEL OVERLAY			AMBER	13581-41151	1
A820	13581-42001	PCB MAIN			AMBER	13581-41001	1
A830	13581-51002	CHASSIS, ALUMINUM			AMBER	13581-51002	1
A840	13581-52002	COVER, ALUMINUM			AMBER	13581-52002	1
A850	13581-53002	HEAT SINK, ALUMINUM			AMBER	13581-53002	1
C801	41031-68000	CAP CERAMIC DISC	680P	20%			1
C802	45041-22030	CAP FILM	0.22	20%			10
C803	45041-22030	CAP FILM	0.22	20%			
C804	45041-22030	CAP FILM	0.22	20%			
C805	41033-27090	CAP CERAMIC NPO	27P	10%			1
C806	41031-10000	CAP CERAMIC DISC	100P	20%			1
C807	41033-39090	CAP CERAMIC NPO	39P	10%			1
C808	45042-47030	CAP FILM	0.22	10%			
C809	45041-68010	CAP FILM	3300P	10%			1
C810	41031-22090	CAP CERAMIC DISC	22P	20%			5
C811	45041-22030	CAP FILM	0.22	20%			
C812	41031-47090	CAP CERAMIC DISC	47P	20%			1
C813	45042-47030	CAP FILM	0.47	10%			1
C814	45041-22030	CAP FILM	0.22	20%			
C815	45041-10030	CAP FILM	0.1	20%			4
C816	45041-22010	CAP FILM	2200P	20%			1
C817	45041-22030	CAP FILM	0.22	20%			
C818	45041-22030	CAP FILM	0.22	20%			
C819	48211-22016	CAP ELECTROLYTIC 16V	22	20%	SIEM	80000/22/16	2
C820	41031-22090	CAP CERAMIC DISC	22P	20%			
C821	45041-10030	CAP FILM	0.1	20%			
C822	41031-22090	CAP CERAMIC DISC	22P	20%			
C823	45041-10030	CAP FILM	0.1	20%			
C824	41031-22090	CAP CERAMIC DISC	22P	20%			
C825	41031-22090	CAP CERAMIC DISC	22P	20%			
C826	45041-22030	CAP FILM	0.22	20%			
C827	45041-22030	CAP FILM	0.22	20%			
C828	48211-22116	CAP ELECTROLYTIC 16V	220	20%	SIEM	81000/220/16	1
C829	48211-22016	CAP ELECTROLYTIC 16V	22	20%	SIEM	81000/22/16	
C830	48211-10125	CAP ELECTROLYTIC 25V	100	20%	SIEM	81000/100/25	1
C831	48211-22025	CAP ELECTROLYTIC 25V	22	20%	SIEM	80000/22/25	2
C832	48211-22025	CAP ELECTROLYTIC 25V	22	20%	SIEM	80000/22/25	
C833		NOT USED					
C834		NOT USED					
C835	45041-10030	CAP FILM	0.1	20%			
D801	21525-57124	LED RECTANGULAR RED			GI	MV 57124	8
D802	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D803	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D804	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D805	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D806	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D807	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D808	21525-57124	LED RECTANGULAR RED			GI	MV 57124	
D809	21521-57742	LED T1 HI-INTEN RED			GI	MV 5774B	3
D810	21521-57742	LED T1 HI-INTEN RED			GI	MV 5774B	

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
D811	21521-57742	LED T1 HI-INTEN RED			GI	MV 5774B	
D820	21035-41480	DIODE GP 500MW				IN4148	12
D821	21035-41480	DIODE GP 500MW				IN4148	
D822	21035-41480	DIODE GP 500MW				IN4148	
D823	21035-41480	DIODE GP 500MW				IN4148	
D824	21035-41480	DIODE GP 500MW				IN4148	
D825	21035-41480	DIODE GP 500MW				IN4148	
D826	21035-41480	DIODE GP 500MW				IN4148	
D827	21035-41480	DIODE GP 500MW				IN4148	
D828	21035-41480	DIODE GP 500MW				IN4148	
D829	21035-41480	DIODE GP 500MW				IN4148	
D830	25929-43030	REGULATOR ADJ SHUNT			TI	TL430CLT	1
D831	21035-41480	DIODE GP 500MW				1N4148	
D832	21035-41480	DIODE GP 500MW				1N4148	
D833	21107-54040	RECTIFIER 3A				IN5404	2
D834	21107-54040	RECTIFIER 3A				IN5404	
J801	73104-20440	CONNECTOR 4PIN R ANG			MOLEX	22-12-2044	3
J802	73104-20440	CONNECTOR 4PIN R ANG			MOLEX	22-12-2044	
J803	73104-20440	CONNECTOR 4PIN R ANG			MOLEX	22-12-2044	
J805	71114-21439	SOCKET LOW PROF	14		AUGAT	214-AG39D	8
J806	71116-21639	SOCKET LOW PROF	16		AUGAT	216-AG39D	11
J807	71140-24039	SOCKET LOW PROF	40		AUGAT	240-AG39D	1
J808	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	6
N801	39734-22010	RNET SIP	2K2		BRNS	4308R102222	1
N802	39734-10020	RNET SIP	10K		BRNS	4308R102103	2
N803	39734-10020	RNET SIP	10K		BRNS	4308R102103	
Q800	22100-34001	TRANSISTOR PWR PNP			TI	TIP34A	1
Q801	22192-44010	TRANSISTOR GP NPN	TO-92			2N4401	3
Q802	22192-44010	TRANSISTOR GP NPN	TO-92			2N4401	
Q803	22192-44010	TRANSISTOR GP NPN	TO-92			2N4401	
Q804	22192-74001	TRANSISTOR FET N-CH	TO-92		TI	TIS74	1
R801	32033-68000	RESISTOR CF 1/4W	680	5%			2
R802	32033-68000	RESISTOR CF 1/4W	680	5%			
R803	32033-22000	RESISTOR CF 1/4W	220	5%			
R804	32003-22000	RESISTOR CF 1/4W	220	5%			5
R805	32033-22000	RESISTOR CF 1/4W	220	5%			
R806	32033-22000	RESISTOR CF 1/4W	220	5%			
R807	32033-22000	RESISTOR CF 1/4W	220	5%			
R810	32033-15020	RESISTOR CF 1/4W	15K	5%			2
R811	32033-10030	RESISTOR CF 1/4W	100K	5%			4
R812	32033-22010	RESISTOR CF 1/4W	2K2	5%			2
R813	32033-22040	RESISTOR CF 1/4W	2M2	5%			2
R814	32033-47030	RESISTOR CF 1/4W	470K	5%			2
R815	32033-22050	RESISTOR CF 1/4W	22M	5%			1
R816	32033-68030	RESISTOR CF 1/4W	680K	5%			1
R817	32033-33030	RESISTOR CF 1/4W	330K	5%			2
R819	32033-15020	RESISTOR CF 1/4W	15K	5%			
R820	32033-27020	RESISTOR CF 1/4W	27K	5%			2
R821	32033-10010	RESISTOR CF 1/4W	1K	5%			3
R822	32033-10040	RESISTOR CF 1/4W	1M	5%			5
R823	32033-47010	RESISTOR CF 1/4W	4K7	5%			2

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
R824	32033-22040	RESISTOR CF 1/4W	2M2	5%			
R825	32033-47020	RESISTOR CF 1/4W	47K	5%			3
R826	32033-22020	RESISTOR CF 1/4W	22K	5%			1
R827	32033-27020	RESISTOR CF 1/4W	27K	5%			
R829	32033-47020	RESISTOR CF 1/4W	47K	5%			
R830	32033-22010	RESISTOR CF 1/4W	2K2	5%			
R831	32033-47020	RESISTOR CF 1/4W	47K	5%			
R832	32033-27010	RESISTOR CF 1/4W	2K7	5%			2
R833	32033-10020	RESISTOR CF 1/4W	10K	5%			5
R834	32033-27010	RESISTOR CF 1/4W	2K7	5%			
R835	32033-10040	RESISTOR CF 1/4W	1M	5%			
R836	32033-10020	RESISTOR CF 1/4W	10K	5%			
R837	32033-10020	RESISTOR CF 1/4W	10K	5%			
R838	32033-10040	RESISTOR CF 1/4W	1M	5%			
R839	32033-10020	RESISTOR CF 1/4W	10K	5%			
R840	32033-10020	RESISTOR CF 1/4W	10K	5%			
R841	32033-47030	RESISTOR CF 1/4W	470K	5%			
R842	32033-33030	RESISTOR CF 1/4W	330K	5%			
R843	32033-10040	RESISTOR CF 1/4W	1M	5%			
R844	32033-10040	RESISTOR CF 1/4W	1M	5%			
R845	32033-10030	RESISTOR CF 1/4W	100K	5%			
R846	32033-68010	RESISTOR CF 1/4W	6K8	5%			2
R847	32033-68010	RESISTOR CF 1/4W	6K8	5%			
R848	32033-10030	RESISTOR CF 1/4W	100K	5%			
R849	32033-10030	RESISTOR CF 1/4W	100K	5%			
R850	32033-47000	RESISTOR CF 1/4W	470	5%			1
R851	32043-47090	RESISTOR CF 1/2W	4.7	5%			1
R852		SHORT					
R853	32033-10000	RESISTOR CF 1/4W	100	5%			2
R854	32033-10000	RESISTOR CF 1/4W	100	5%			
R855	32033-10010	RESISTOR CF 1/4W	1K	5%			
R856	32033-10010	RESISTOR CF 1/4W	1K	5%			
R857	32033-47010	RESISTOR CF 1/4W	4K7	5%			
S800	84111-22102	PUSH BUT MOM LT GREY			LICON	39-22102	1
S801	84111-22103	PUSH BUT MOM DK GREY			LICON	39-22103	2
S802	84111-22103	PUSH BUT MOM DK GREY			LICON	39-22103	
S803	84111-22504	PUSH BUT MOM BLACK			LICON	39-22504	1
U800	29002-72261	LSI COUNTER			INTSL	ICM7226AIDL	1
U801	25301-32410	QUAD OP AMP			NSC	LM324N	2
U802	25301-32410	QUAD OP AMP			NSC	LM324N	
U803	24031-40760	QUAD D-TYPE REGISTER				CD4076B	2
U810	24031-40520	DUAL 4X1 SWITCH				CD4052B	1
U811	24031-45840	HEX SCHMITT INVERT				CD4584B	1
U812	24031-40010	QUAD DUAL INPUT NOR				CD4001B	2
U813	24031-40760	QUAD D-TYPE REGISTER				CD4076B	
U814	24031-40280	BCD/DECIMAL DECODER				CD4028B	1
U820	24031-40130	DUAL D FLIP FLOP				CD4013B	2
U821	24031-40130	DUAL D FLIP FLOP				CD4013B	
U822	24031-40010	QUAD DUAL INPUT NOR				CD4001B	
U823	24031-40750	TRIPLE 3 INPUT OR				CD4075B	1
U824	24031-40810	QUAD INPUT AND				CD4081B	1

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
U830	24031-45380	DUAL MONO MULTIVIBRA				CD4538B	1
U831	24031-45180	DUAL BCD UP COUNTER				CD4518B	1
U832	24031-40460	PHASE LOCKED LOOP				CD4046B	1
U833	25302-31110	FET INPUT COMPARATOR			TI	TL311P	1
U834	25211-08200	OP AMP DUAL BI-FET			TI	TLO82CP	3
U835	24031-40530	TRIPLE 2 X 1 SWITCH				CD4053B	1
U840	25922-34005	+5V LINEAR REGULATOR	TO220			LM340-05	1
U841	25211-08200	OP AMP DUAL BI-FET			TI	TLO82CP	
U842	25211-08200	OP AMP DUAL BI-FET			TI	TLO82CP	
V801	51919-73500	CAP VARIABLE	7-25		ERIE	538-001B7-25	1
V802	51415-50020	TRIMPOT CERMET	50K	10%	BRNS	3386P-1-503	1
V803	51415-10020	TRIMPOT CERMET	10K	10%	BRNS	3386P-1-103	1
W800	58800-01700	FLEX STRIP				FSN-22A-17	2
W801	58800-01700	FLEX STRIP				FSN-22A-17	
X800	52001-10004	CRYSTAL,PAR RES/22P	10MHZ	0.01%			1
Y801	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	6
Y802	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	
Y803	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	
Y804	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	
Y805	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	
Y806	21633-36101	DISPLAY COMMON ANODE			GI	MAN3610A	
J809	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	
J810	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	
J811	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	
J812	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	
J813	71516-31435	SOCKET WIRE WRAP	14		AUGAT	314-AG35F	

AMBER MODEL 358

HIGH RESOLUTION FREQUENCY METER

Issue 01

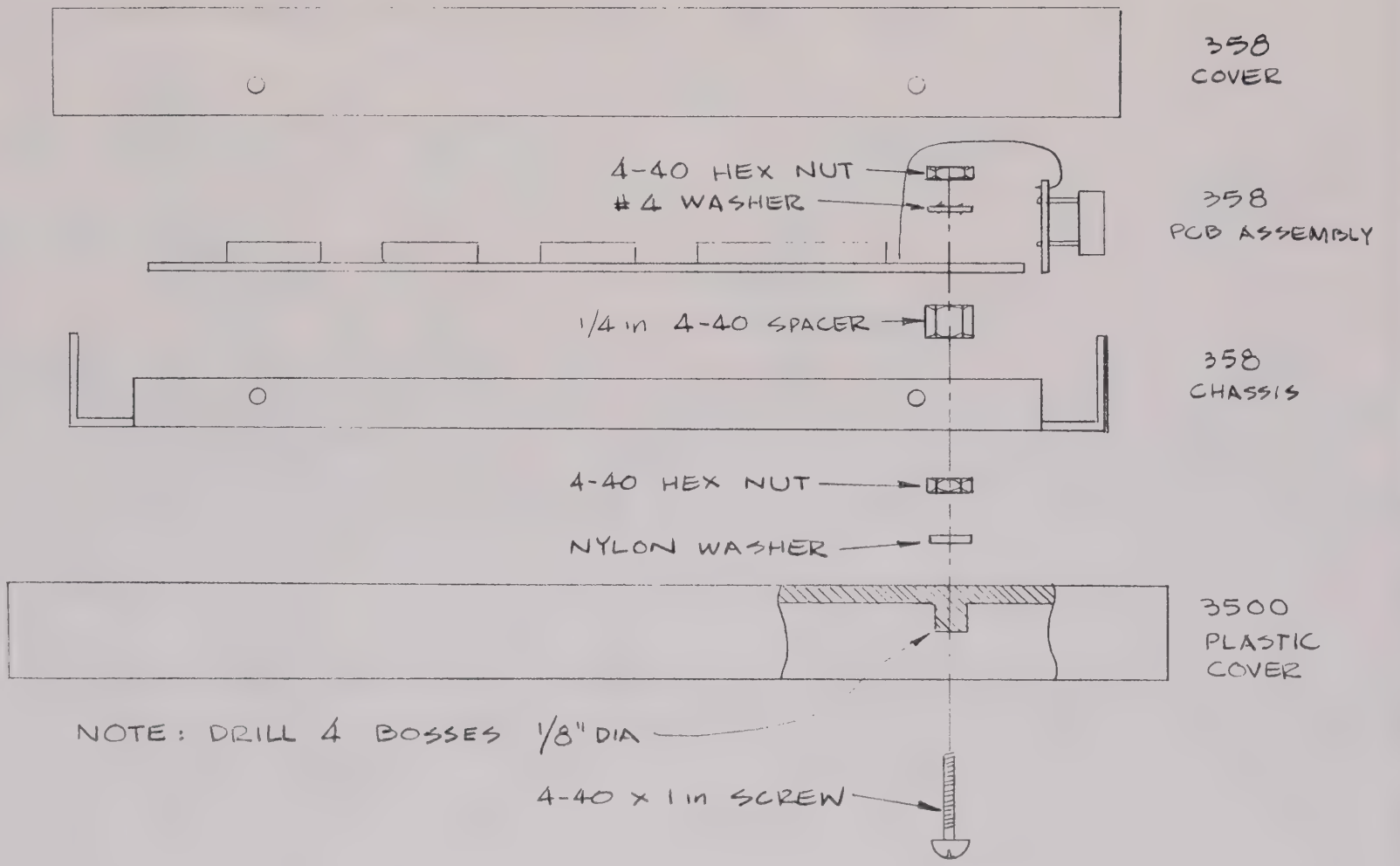
September 1981

OWNER'S MANUAL

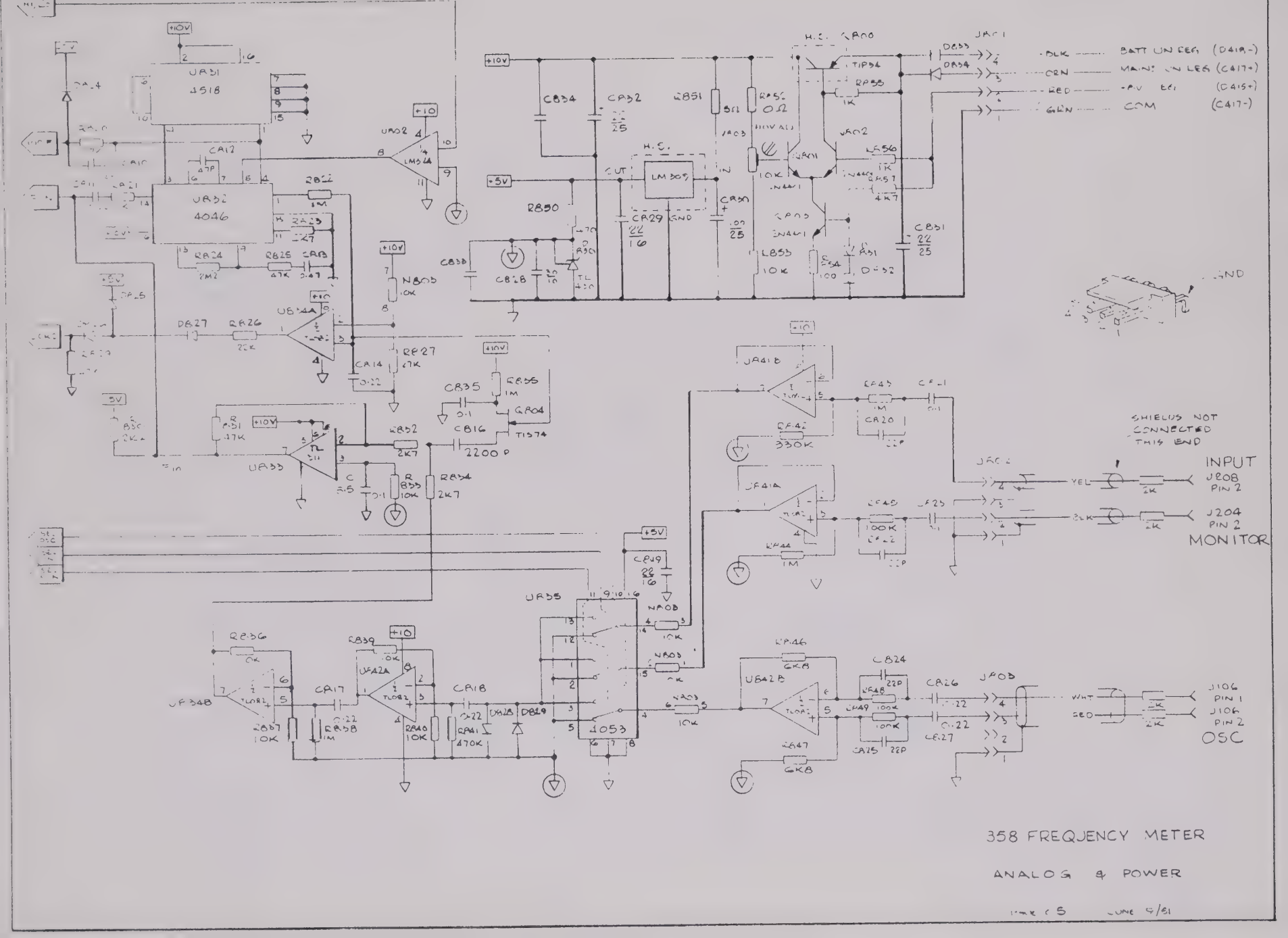
SECTION 7

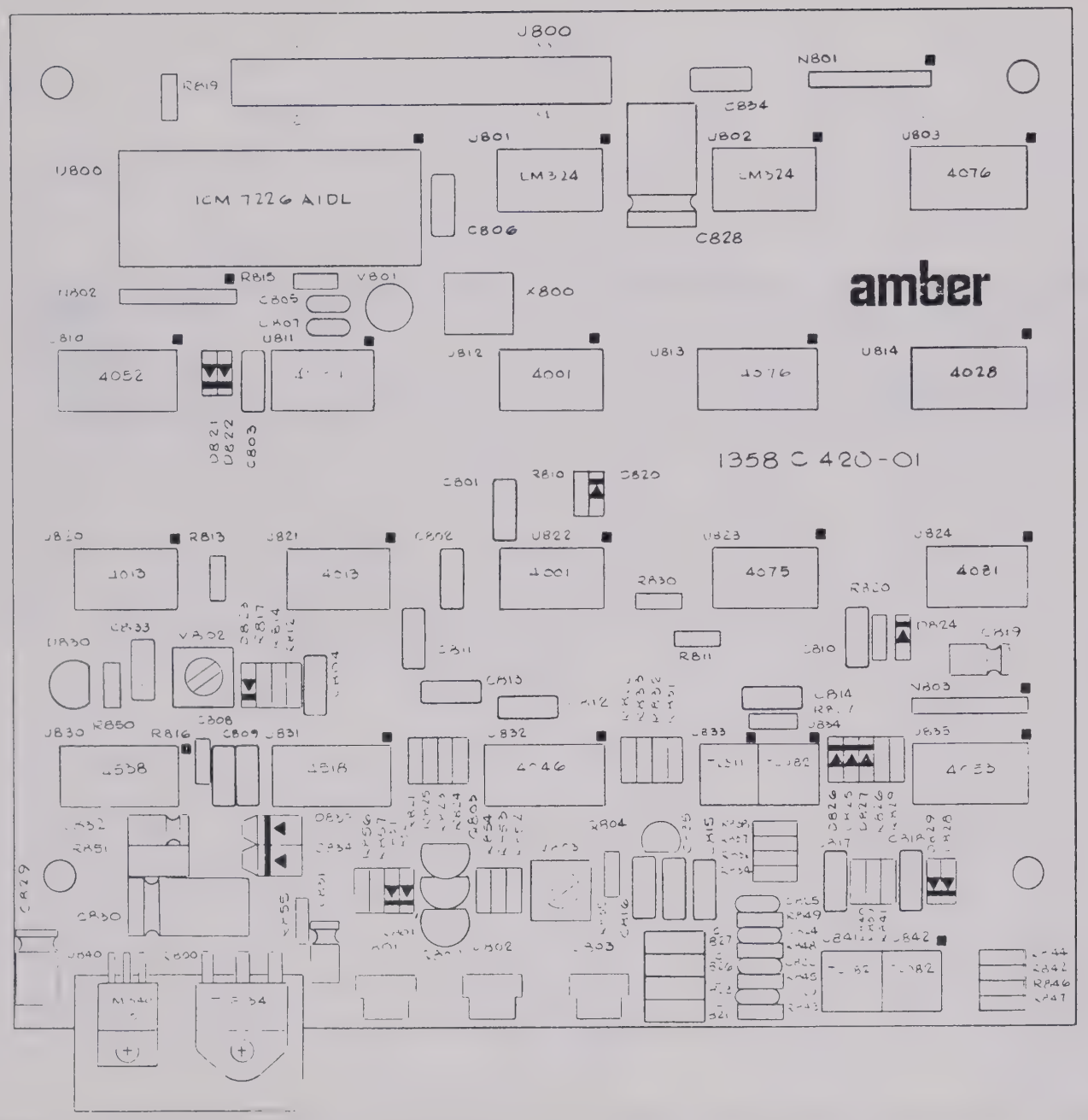
SCHEMATICS & COMPONENT LAYOUTS

Assembly details model 358 & model 3500
(One of four typical mounting screws shown)

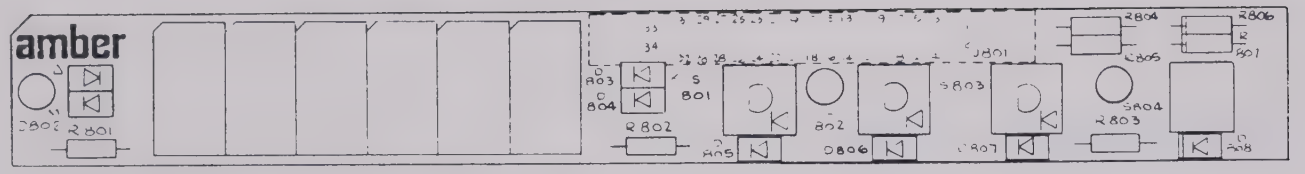


AUG 26, 1981


+10V
+5V
-5V
-10V
UA31
4518
UA32
4046
UA33
4053
LM309
LM324
TIP34
TIP33
SHIELDS NOT CONNECTED THIS END
INPUT
J208 PIN 2
J204 PIN 2
MONITOR
J106 PIN 1
J106 PIN 2
OSC
BLK BATT UN REG (D419-)
ORN MAINS UN REG (C417+)
RED -5V REG (D415+)
GRN COM (C417-)
358 FREQUENCY METER
ANALOG & POWER
SHEET 5 OF 5
JUNE 6/81

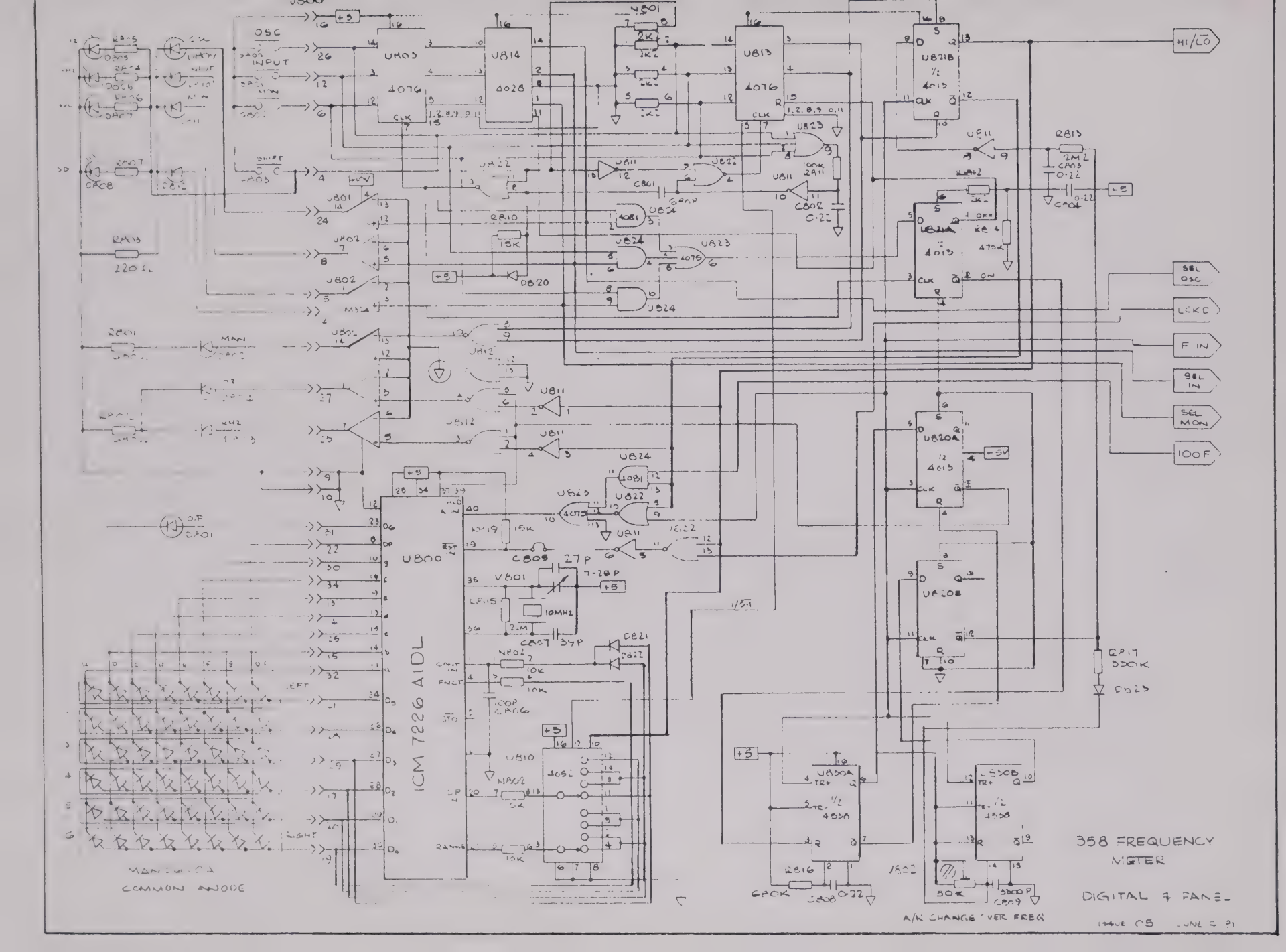


AMBER ELECTRO DESIGN LTD	
358 FREQ METER PCB COMPONENT LAYOUT	
JUNE 18/81	1358 C 420-02



135P, SILK SCREEN

AMBER ELECTRO DESIGN LTD	
358 FREQUENCY METER	
PANEL PCB SCREENING	
JUNE 9,21	358C411-02


OSC
INPUT
UH05
4076
UB14
4028
UB13
4076
UB21B
4013
UB21A
4013
UB20A
4013
UB20B
4013
UB23
4075
UB24
4081
UB22
UB11
UB12
UB10
4052
UB800
ICM 7226 AIDL
V801
7-28P
10MHz
27P
34P
CB05
CB07
HI/LO
SEL OSC
LOCK
F IN
SEL IN
SEL MON
100F
+5
+8
+9V
MAN
COMMON ANODE
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